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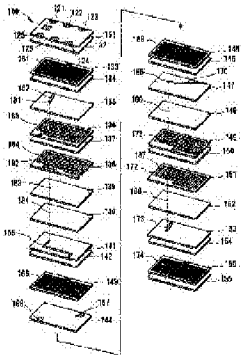
(54) LAMINATED BALANCE ELEMENT



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a laminated balance element, capable of being easily designed, so as not to bring about a large difference between

outputs and phases of signals of a first balanced terminal and a second balanced terminal, when it is mounted in a main apparatus.

SOLUTION: The laminated balance element 100 comprises a third coupling line 164 having a set changing unit including an inductance set, so that the difference of amplitudes of impedances and the phase difference of the signals of the first balanced terminal 124 and the second balanced terminal 123 fall within prescribed allowed ranges at a ground terminal; a connecting line 165 for connecting another end of the third coupling 164 to the first terminal 124 and set to have a prescribed inductance as a set changing unit; conductor pieces 167, 168 having prescribed capacitances of an unbalanced terminal 126; and the second balanced terminal 123 connected as the set changing unit. Thus, a reactance of the set changing unit is changed at a resetting tie matched with the mounting environment to obtain proper characteristics.

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CLAIMS

[Claim(s)]

[Claim 1] While having 2 sets of tie ways, using as 1 set at least two tie ways where a laminating is carried out, it is formed, and an electromagnetic coupling is carried out mutually, and each constitutes a quarter-wave length resonator so that it may lap with the interior of a laminating element assembly mutually through an insulator layer In the laminating balun component which has the unbalance terminal and the 1st and 2nd balance terminal which are exposed outside, and an earth terminal, and combines the unbalance transmission line and a balanced transmission line The laminating balun component to which the setting modification section which has the reactance set up so that the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal might come in predetermined tolerance is characterized by being prepared in the edge of at least one tie way in said tie way.

[Claim 2] Said setting modification section is a laminating balun component according to claim 1 characterized by the track width of face of the setting modification section differing from the track width of face of parts other than the setting modification section in the part which does not suit in this pile while having the part which do not overlap to other tie ways which are said a part of tie ways, and carry out an electromagnetic coupling mutually.

[Claim 3] The laminating balun component according to claim 2 characterized by setting up more thinly than the track width of face of parts other than the setting modification section the track width of face of said setting modification section so that said setting modification section may have a predetermined inductance.
[Claim 4] The laminating balun component according to claim 2 characterized by setting up more thickly than the track width of face of the part outside a setting modification part the track width of face of said setting modification section so that said setting modification section may have predetermined capacitance.
[Claim 5] Between at least 1 of said unbalance terminals and 1st and 2nd balance terminals, and said tie way corresponding to this terminal The path cord way which connects between these is prepared as said setting modification section, and said path cord way is formed in a different layer from the layer in which said tie way is formed. The thickness of the insulator layer which intervenes between the tie ways connected to said path cord way and said path cord way is a laminating balun component according to claim 1 characterized by being set up more greatly than the thickness of the insulator layer which intervenes between the tie ways by which the laminating was carried out by said 1 set of inside adjoining each other.
[Claim 6] the conductor with which the end was connected to the edge of said tie way, and the other end was wide opened as said setting modification section -- the laminating balun component according to claim 1 characterized by preparing the opening stub which consists of a track and has a predetermined reactance.
[Claim 7] the conductor which is prepared in the interior of said laminating element assembly, and has predetermined capacitance to at least one terminal in said unbalance terminal and 1st balance terminal, and the 2nd balanced terminal -- a laminating balun component given in any of claim 1 characterized by connecting the piece as said setting modification section thru/or claim 6 they are.
[Claim 8] nothing, said unbalance terminal, and the 1st and 2nd balance terminal extend the rectangular parallelepiped configuration which has the base which counters the field in which a laminating balun component is carried from said

base on the side face of said laminating element assembly on the top face, and said laminating element assembly forms it -- having -- **** -- said conductor -- the laminating balun component according to claim 7 characterized by preparing the piece near said laminating element assembly top face.

[Claim 9] The 1st tie way where the end was connected to said unbalance terminal, and the 2nd tie way where the end was opened wide and the other end was connected to the other end of said 1st tie way, The 3rd tie way which the other end is connected to said 1st balance terminal, and it is arranged so that it may lap with said 1st tie way through an insulator layer, and carries out an electromagnetic coupling to said 1st tie way while an end is connected to said earth terminal, The 4th tie way which the other end is connected to the 2nd balance terminal, and it is arranged so that it may lap with said 2nd tie way through an insulator layer, and carries out an electromagnetic coupling to said 2nd tie way while an end is connected to a touch-down external terminal, the touch-down which is connected to said earth terminal and controls the electromagnetic coupling between the group of one [said] tie way, and the group of the tie way of another side -- a laminating balun component given in any of claim 1 characterized by having the conductor thru/or claim 8 they are.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the balun component which intervenes between a balanced transmission line and the unbalance transmission line in pocket mold telephone or pocket mold wireless radios, and combines between these two different transmission lines.

[0002]

[Description of the Prior Art] In order to take adjustment between these, the balun is made to intervene, since an antenna side serves as the unbalance transmission line and a transceiver circuit side serves as the balanced transmission line, when connecting a transceiver circuit and an antenna in pocket mold telephone or pocket mold wireless radios conventionally. Baluns are a balance and unbalance converter of the RF transmission line here.

[0003] In recent years, the laminating balun component which pocket mold telephone and pocket mold wireless radios laid the conductor underground inside what the inclination of a miniaturization and high-frequency-izing became strong, and the balun was also miniaturized in connection with this, and twisted and formed lead wire in the ferrite core to the laminating element assembly, and formed them has come to be used.

[0004] An example of this kind of laminating balun component is shown in drawing 2 and drawing 3 . Drawing 2 is [the representative circuit schematic and drawing 4 of an external view and drawing 3] decomposition perspective views. In drawing, 200 is a laminating balun component and consists of the laminating element assembly 210 of a rectangular parallelepiped configuration, and the external terminals 221-226 formed in the outside surface. Here, the external terminal 226 is an unbalance terminal connected to the unbalance transmission line, and the 1st balance terminal by which the external terminal 224 is connected to one side of one pair of balanced transmission lines, the 2nd

balance terminal by which the external terminal 223 is connected to the balanced line of another side, and the external terminal 222,225 are terminals an external circuit and connectionless in an earth terminal and the external terminal 221.

[0005] the laminating element assembly 21 is shown in drawing 4 -- as -- a front face -- touch-down -- the laminating of the dielectric layer 232,242,251 in which the conductor 261,266,271 was formed, the dielectric layer 236,238,246,248 by which the curled form tie way 263,264,268,269 was established in the front face, the dielectric layer 234,240,244,250 by which the path cord way 262,265,267,270 which connects a tie way and an external terminal was established in the front face, and the dummy dielectric layers 231, 233, 235, 237, 239, 241, 243, and 245,247,249,252 is carried out, and they are constituted.

[0006] The end of the tie way 269 is connected to the external terminal (unbalance terminal) 226, and the other end is connected to the end of the tie way 263 through the path cord way 270,262. The other end of the tie way 263 is opened wide.

[0007] Moreover, the end of the tie way 264 is connected to the external terminal (the 1st balance terminal) 223 through the path cord way 265, and the other end is connected to the earth terminal 225. The end of the tie way 268 is connected to the external terminal (the 2nd balance terminal) 224 through the path cord way 267, and the other end is connected to the earth terminal 225.

[0008] The electromagnetic coupling of the tie way 263 and the tie way 264 is mutually carried out through a dielectric layer 236,237, and they are carrying out the electromagnetic coupling of the tie way 268 and the tie way 269 mutually through the dielectric layer 246,247. These tie ways 263,264,268,269 are formed of the stripline of the predetermined width of face whose electric merit according to the center frequency of the signal which spreads the transmission line which intervenes this component 200 is quarter-wave length.

[0009] moreover, between the tie ways and path cord ways which are formed in the front face of different dielectric zonula layer -- a beer hall -- it connects with conductors 281-283 -- having -- the path cord way 262,265,267,270 -- a beer hall

-- it is formed in accordance with the shortest path between a conductor and an external terminal.

[0010]

[Problem(s) to be Solved by the Invention] However, in the laminating balun component of the conventional example mentioned above, the difference might arise greatly in the impedance and phase of the 1st balance terminal and the 2nd balance terminal by the difference among mounting environments, such as arrangement of the conductor of the perimeter when mounting to the circuit board of the main unit, and electronic parts. For example, it became a property as shown in the Smith chart of drawing 5 depending on a mounting environment, and the difference between the property B of the 1st balance terminal 223 and the property C of the 2nd balance terminal 224 became large. Drawing 5 is a property in the frequency of 2.0GHz - 3.0GHz.

[0011] Consequently, as shown in drawing 6 , the difference between the amplitude between the output signal of the 1st balance terminal 223 and the output signal of the 2nd balance terminal 224 and a phase might become large. For this reason, the design had to be redone whenever the main unit changed. In this redesign, while taking very much time amount, there was a trouble that the cost of a component became high and could not provide at a low price.

[0012] When mounted in the main unit in view of the above-mentioned trouble, the purpose of this invention is offering the laminating balun component which can be designed easily, as the output of the signal of the 1st balance terminal and the 2nd balance terminal and a phase are alike, respectively and a big difference does not arise.

[0013]

[Means for Solving the Problem] This invention in order to attain the above-mentioned purpose in claim 1 While having 2 sets of tie ways, using as 1 set at least two tie ways where a laminating is carried out, it is formed, and an electromagnetic coupling is carried out mutually, and each constitutes a quarter-wave length resonator so that it may lap with the interior of a laminating element

assembly mutually through an insulator layer In the laminating balun component which has the unbalance terminal and the 1st and 2nd balance terminal which are exposed outside, and an earth terminal, and combines the unbalance transmission line and a balanced transmission line The setting modification section which has the reactance set up so that the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal might come in predetermined tolerance proposes the laminating balun component prepared in the edge of at least one tie way in said tie way.

[0014] According to this laminating balun component, the value of the reactance of said setting modification section changes at the time of a design, and the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal are set up in said tolerance. Thereby, according to the mounting environment of a balun component, it can design easily in a short time so that the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal may come in predetermined tolerance.

[0015] Moreover, in claim 2, in a laminating balun component according to claim 1, said setting modification section proposes the laminating balun component for which the track width of face of the setting modification section differs from the track width of face of parts other than the setting modification section in the part which does not suit in this pile while having the part which do not overlap to other tie ways which are said a part of tie ways, and carry out an electromagnetic coupling mutually.

[0016] According to this laminating balun component, said a part of tie way is made into the setting modification section, and said tie way containing said setting modification section is making the quarter-wave length resonator. furthermore, the configuration where the track width of face of the setting modification section differed from the track width of face of parts other than the setting modification section in the part which the tie way containing said setting modification section has the part which do not overlap in said setting modification section to other tie ways which carry out an electromagnetic coupling mutually,

and does not suit in this pile -- for example, it is formed thinly or thickly and has a predetermined reactance.

[0017] Moreover, in claim 3, in a laminating balun component according to claim 2, the laminating balun component to which the track width of face of said setting modification section is set more thinly than the track width of face of parts other than the setting modification section is proposed so that said setting modification section may have a predetermined inductance.

[0018] According to this laminating balun component, the track width of face of said setting modification section is formed more thinly than the track width of face of parts other than the setting modification section, and it is set up so that said setting modification section may have a predetermined inductance.

[0019] Moreover, in claim 4, in a laminating balun component according to claim 2, the laminating balun component to which the track width of face of said setting modification section is set more thickly than the track width of face of the part outside a setting modification part is proposed so that said setting modification section may have predetermined capacitance.

[0020] According to this laminating balun component, the track width of face of said setting modification section is formed more thickly than the track width of face of parts other than the setting modification section, and it is set up so that said setting modification section may have predetermined capacitance.

[0021] In claim 5, in a laminating balun component according to claim 1 moreover, between at least 1 of said unbalance terminals and 1st and 2nd balance terminals, and said tie way corresponding to this terminal The path cord way which connects between these is prepared as said setting modification section, and said path cord way is formed in a different layer from the layer in which said tie way is formed. The thickness of the insulator layer which intervenes between the tie ways connected to said path cord way and said path cord way proposes the laminating balun component set up more greatly than the thickness of the insulator layer which intervenes between the tie ways by which the laminating was carried out by said 1 set of inside adjoining each other.

[0022] According to this laminating balun component, the path cord way which connects between these is prepared as said setting modification section between said tie ways corresponding to any one and this terminal at least of said unbalance terminals and 1st and 2nd balance terminals. Furthermore, the thickness of the insulator layer which intervenes between the tie ways which said path cord way is formed in a different layer from the layer in which said tie way is formed, and are connected to said path cord way and said path cord way Or it weakens the electromagnetic coupling between said tie ways, in order to lose, it is set up more greatly than the thickness of the insulator layer which intervenes between the tie ways by which the laminating was carried out by said 1 set of inside adjoining each other.

[0023] moreover, the conductor with which the end was connected to the edge of said tie way, and the other end was wide opened as said setting modification section in the laminating balun component according to claim 1 in claim 6 -- the laminating balun component in which the opening stub which consists of a track and has a predetermined reactance is prepared is proposed.

[0024] According to this laminating balun component, an opening stub is connected to the edge of said tie way, and this opening stub has a predetermined reactance as said setting modification section.

[0025] moreover, the conductor which is prepared in the interior of said laminating element assembly, and has predetermined capacitance in claim 7 to at least one terminal in said unbalance terminal and 1st balance terminal, and the 2nd balanced terminal in a laminating balun component given in any of claim 1 thru/or claim 6 they are -- a piece proposes the laminating balun component connected as said setting modification section.

[0026] according to this laminating balun component -- at least one terminal in said unbalance terminal and 1st balance terminal, and the 2nd balanced terminal -- a conductor -- a piece connects -- having -- this -- a conductor -- a piece serves as said setting modification section which has predetermined capacitance, and is connected to the edge of said tie way.

[0027] moreover, in claim 8, in a laminating balun component according to claim 7, nothing, said unbalance terminal, and the 1st and 2nd balance terminal extend the rectangular parallelepiped configuration which has the base which counters the field in which a laminating balun component is carried from said base on the side face of said laminating element assembly on the top face, and said laminating element assembly forms it -- having -- **** -- said conductor -- a piece proposes the laminating balun component prepared near said laminating element assembly top face.

[0028] According to this laminating balun component, said laminating element assembly has a rectangular parallelepiped configuration, since said unbalance terminal and 1st and 2nd balance terminal are extended and formed in the side face of said laminating element assembly from the base on the top face, the part of the upper part (the top face of said laminating element assembly near [i.e.,]) of these terminals may serve as an unnecessary opening stub, and the reactance may change with change of a mounting environment. however, said conductor -- since the piece is prepared near said laminating element assembly top face, said unnecessary opening stub is formed -- there is nothing -- further -- the time of a design -- setting -- said conductor -- since the capacitance of a piece is set as the optimal value, the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal come in said tolerance.

[0029] Moreover, in claim 9, it sets for a laminating balun component given in any of claim 1 thru/or claim 8 they are. The 1st tie way where the end was connected to said unbalance terminal, and the 2nd tie way where the end was opened wide and the other end was connected to the other end of said 1st tie way, The 3rd tie way which the other end is connected to said 1st balance terminal, and it is arranged so that it may lap with said 1st tie way through an insulator layer, and carries out an electromagnetic coupling to said 1st tie way while an end is connected to said earth terminal, The 4th tie way which the other end is connected to the 2nd balance terminal, and it is arranged so that it may lap with

said 2nd tie way through an insulator layer, and carries out an electromagnetic coupling to said 2nd tie way while an end is connected to a touch-down external terminal, the touch-down which is connected to said earth terminal and controls the electromagnetic coupling between the group of one [said] tie way, and the group of the tie way of another side -- a laminating balun component equipped with the conductor is proposed.

[0030] Said 3rd tie way which carries out an electromagnetic coupling to said 1st tie way according to this laminating balun component, said 4th tie way which carries out an electromagnetic coupling to said 2nd tie way -- having -- the inside of these 1st thru/or 4th tie way -- said setting modification section prepares in any one at least -- having -- said touch-down -- the electromagnetic coupling between the group of one [said] tie way and the group of the tie way of another side is controlled with a conductor.

[0031]

[Embodiment of the Invention] Hereafter, 1 operation gestalt of this invention is explained based on a drawing.

[0032] An appearance perspective view and drawing 8 of the decomposition perspective view and drawing 7 which show the configuration of a laminating balun component [in / in drawing 1 / the 1st operation gestalt of this invention] are the representative circuit schematic. In drawing, 100 is a laminating balun component, it consists of a laminating element assembly 110 of a rectangular parallelepiped configuration with which the tie way was formed in the internal layer, it extends from a base to the outside surface of this laminating element assembly 110 on the top face, and the external terminals 121-126 are formed. The external terminals 121 are an external circuit and a connectionless terminal, and have connected the 1st tie way and the 2nd tie which are mentioned later. The external terminals 122,125 are an earth terminal, the unbalance terminal by which the external terminal 126 is connected to the unbalance transmission line, the 1st balance terminal by which the external terminal 124 is connected to one side of one pair of balanced transmission lines, and the 2nd balance terminal by

which the external terminal 123 is connected to the balanced line of another side.
[0033] the laminating element assembly 110 carries out the laminating of two or more dielectric layers (insulator layer) 131-156 which have the respectively same thickness as shown in drawing 1 , and constitutes them -- having -- **** -- the dielectric layer of a predetermined layer -- a front face -- a tie way or connection -- a conductor or touch-down -- the conductor is prepared.
[0034] drawing 1 -- setting -- the maximum upper layer and the dielectric layer 131,132 of the 2nd layer -- a dummy layer -- it is -- the front face of the dielectric layer 133 of the 3rd layer -- touch-down -- the conductor 161 is formed. this touch-down -- the conductor 161 is connected to the external terminal 122 used as an earth terminal.
[0035] The dielectric layer 134 of the 4th layer is a dummy layer.
[0036] the front face of the dielectric layer 135 of the 5th layer -- connection -- the conductor 162 is formed. connection -- the beer hall where the end is connected to the external terminal 121, and a conductor 162 penetrates a dielectric layer 135 from a front face at the rear face to the other end -- a conductor 181 is formed and it is making band-like [which connects an end and the other end with the shortest path].
[0037] The 1st tie way 163 is established in the front face of the dielectric layer 136 of the 6th layer. as shown in drawing 9 , the end 163a connects the 1st tie way 163 to the external terminal 126 -- having -- other end 163b -- a beer hall -- the curled form arranged in the location linked to a conductor 181 is made. This 1st tie way 163 constitutes the quarter-wave length resonator according to the center frequency of the signal which intervenes this component 100 and spreads the transmission line.
[0038] The dielectric layer 137 of the 7th layer is a dummy layer.
[0039] As shown in drawing 10 , the curled form 3rd tie way 164 is established in the front face of the dielectric layer 138 of the 8th layer so that 164d of other parts except end section 164c may lap with the 1st tie way 163. moreover, end 164a of the 3rd tie way 164 is connected to the external terminal 125 used as an

earth terminal, and other end 164b is arranged in the same location as other end 163b of the 1st tie way 163 -- having -- a beer hall -- the conductor 182 is formed. Furthermore, end section 164c of the 3rd tie way 164 is made into the setting modification section, and the width of face W1 of end section 164c is formed more thinly than the width of face W2 of 164d of other parts, it is arranged so that the great portion of end section 164c may not lap with the 1st tie way 163, and end section 164c currently formed thinly has the predetermined inductance L1.

[0040] This 3rd tie way 164 doubles 164d of parts of end section 164c and others, and constitutes the quarter-wave length resonator according to the center frequency of the signal which intervenes this component 100 and spreads the transmission line.

[0041] the beer hall which the 9th and the dielectric layer 139,140 of the 10th layer are dummy layers, and was formed in the other end of the 3rd tie way 164 -- the location corresponding to a conductor 182 -- respectively -- a beer hall -- a conductor 183,184 prepares -- having -- these beer halls -- conductors 182-184 are connected.

[0042] The path cord way 165 is established in the front face of the dielectric layer 141 of the 11th layer as the setting modification section. band-like [which crosses a right angle mutually as the path cord way 165 is shown in drawing 11 / three] -- a conductor -- nothing and its end 165a connect to the external terminal 124 the abbreviation configuration for Z characters which connected the piece with the serial -- having -- other end 165b -- a beer hall -- it arranges in the location corresponding to a conductor 184 -- having -- a beer hall -- it connects with the conductor 184. moreover, connection -- a conductor 165 has the predetermined inductance L2 -- as -- connection -- the width of face and die length of a conductor 165, and arrangement are set up.

[0043] The dielectric layer 142 of the 12th layer is a dummy layer.

[0044] the front face of the dielectric layer 143 of the 13th layer -- touch-down -- the conductor 166 is formed. this touch-down -- the conductor 166 is connected to the external terminal 122 used as an earth terminal.

[0045] the front face of the dielectric layer 144 of the 14th layer -- two conductors -- the piece 167,168 is formed as the setting modification section. one conductor -- the touch-down which it connected with the external terminal 123, and the piece 167 was formed in about 123 external terminal predetermined area, and was formed in the adjacent layer -- the capacitance C1 predetermined between conductors 166,169 is formed. the conductor of another side -- the touch-down which it connected with the external terminal 126, and the piece 168 was formed in about 126 external terminal predetermined area, and was formed in the adjacent layer -- the capacitance C2 predetermined between conductors 166,169 is formed.

[0046] the front face of the dielectric layer 145 of the 15th layer -- touch-down -- the conductor 169 is formed. this touch-down -- the conductor 169 is connected to the external terminal 122 used as an earth terminal.

[0047] The dielectric layer 146 of the 16th layer is a dummy layer.

[0048] the front face of the dielectric layer 147 of the 17th layer -- connection -- the conductor 170 is formed. connection -- the beer hall where the end is connected to the external terminal 123, and a conductor 170 penetrates a dielectric layer 147 from a front face at the rear face to the other end -- a conductor 185 is formed and it is making band-like [which connects an end and the other end with the shortest path].

[0049] the beer hall which the dielectric layer 148 of the 18th layer is a dummy layer, and was formed in the other end of the path cord way 170 -- the location corresponding to a conductor 185 -- a beer hall -- a conductor 186 prepares -- having -- these beer halls -- the conductor 185,186 is connected.

[0050] The 4th tie way 171 is established in the front face of the dielectric layer 149 of the 19th layer. as shown in drawing 12 , the end 171a connects the 4th tie way 171 to the external terminal 125 used as an earth terminal -- having -- the other end -- a beer hall -- the curled form arranged in the location linked to a conductor 186 is made. This 4th tie way 171 constitutes the quarter-wave length resonator according to the center frequency of the signal which intervenes this

component 100 and spreads the transmission line.
[0051] The dielectric layer 150 of the 20th layer is a dummy layer.
[0052] As shown in drawing 13 , the curled form 2nd tie way 172 is established in the front face of the dielectric layer 151 of the 21st layer so that it may lap with the 4th tie way 171. moreover, end 172a of the 2nd tie way 172 is opened wide, and other end 172b is arranged in the same location as other end 171b of the 4th tie way 171 -- having -- a beer hall -- the conductor 187 is formed. This 2nd tie way 172 constitutes the quarter-wave length resonator according to the center frequency of the signal which intervenes this component 100 and spreads the transmission line.
[0053] the beer hall which the dielectric layer 152 of the 22nd layer is a dummy layer, and was formed in the other end of the 2nd tie way 172 -- the location corresponding to a conductor 187 -- a beer hall -- a conductor 188 prepares -- having -- these beer halls -- the conductor 187,188 is connected.
[0054] the front face of the dielectric layer 153 of the 23rd layer -- connection -- the conductor 173 is formed. connection -- the end connects a conductor 173 to the external terminal 121 -- having -- the other end -- a beer hall -- it is arranged in the location connected to a conductor 188, and is making band-like [which connects an end and the other end with the shortest path].
[0055] The dielectric layer 154 of the 24th layer is a dummy layer.
[0056] the front face of the dielectric layer 155 of the 25th layer -- touch-down -- the conductor 174 is formed. this touch-down -- the conductor 174 is connected to the external terminal 122 used as an earth terminal.
[0057] The dielectric layer 156 of the 26th layer is a dummy layer.
[0058] By the above-mentioned configuration, the 1st tie way 163 and the 3rd tie 164 carry out an electromagnetic coupling, and the 2nd tie way 172 and the 4th tie way 171 carry out an electromagnetic coupling. furthermore, the electromagnetic coupling between the groups of the tie way of another side which while consists of the 1st tie way 163 and the 3rd tie way 164, and consists of a group of a tie way, and the 2nd tie way 172 and the 4th tie way 171 -- touch-

down -- it is controlled with the conductor 166,169.

[0059] With the laminating balun component 100 of the above-mentioned configuration, since the four setting modification sections are prepared, as the equal circuit is shown in drawing 8 , an inductance L1 intervenes between the 1st parallel terminal 124 and the 3rd tie way 164, and an inductance L2 intervenes between the 3rd tie way 164 and touch-down. Furthermore, capacitance C1 intervenes between the 2nd balance terminal 123 and touch-down, and capacitance C2 intervenes between the unbalance terminal 126 and touch-down. The output difference and phase contrast of a signal of the 1st balance terminal 124 and the 2nd balance terminal 123 are set up in predetermined tolerance with these inductances L1 and L2 and capacitance C1 and C2. When the Smith chart in the frequency of 2.0GHz - 3.0GHz of the laminating balun component 100 of this operation gestalt was created, the property as shown in drawing 14 was acquired. In drawing 14 , A expresses the property of the unbalance terminal 126, B expresses the property of the 1st balance terminal 124, and C expresses the property of the 2nd balance terminal 123, respectively. As shown in drawing 14 , a difference of the property between the property B of the 1st balance terminal 124 and the property C of the 2nd balance terminal 123 decreases sharply compared with the conventional example mentioned above, and is almost the same. Consequently, as shown in drawing 15 , with the laminating balun component 100 of this operation gestalt, most differences between the amplitude between the output signal of the 1st balance terminal 124 and the output signal of the 2nd balance terminal 123 and a phase were lost.

[0060] Therefore, by preparing the setting modification section like this operation gestalt, even if the main unit using a laminating balun component changes, the laminating balun component which has the always optimal property can be offered. Furthermore, since the time and effort and cost in the case of redesigning whenever the main unit changes are sharply reducible compared with the former, the cheap laminating balun component 100 can be offered.

[0061] In addition, although it was made to lose with this operation gestalt or it

made the dielectric layers 138-140 of three sheets intervene between the path cord way 165 as the setting modification section, and the 3rd tie way 164 and weakened the electromagnetic coupling between the path cord way 165 and the 3rd tie way 164 The sum total of the thickness of the dielectric layers 138-140 which intervene between the path cord way 165 as the setting modification section, and the 3rd tie way 164 It is desirable to set up more greatly than the sum total of the thickness of the dielectric layer 136,137 which exists between the 1st tie way 163 and the 3rd tie way 164, for example, it is desirable to set it as 1.5 or more times.

[0062] Next, the 2nd operation gestalt of this invention is explained.

[0063] The laminating balun component which formed the 3rd tie way 310 of the configuration which replaces with the 3rd tie way 164 formed in the dielectric layer 138 of the 8th layer in the 1st operation gestalt mentioned above, and is shown in drawing 16 consisted of 2nd operation gestalten.

[0064] nothing and its end 310a are connected to the external terminal 125 used as an earth terminal, and other end 310b arranges the shape of spiral shape to which the 3rd tie way 310 laps with the 1st tie way 163 in the same location as other end 163b of the 1st tie way 163 -- having -- a beer hall -- the conductor 182 is formed. Furthermore, the end section 311 of the 3rd tie way 310 is made into the setting modification section, and width-of-face W3 of the end section 311 is formed more thickly than the width of face W2 of the other parts 312, it is arranged so that the periphery part of the end section 311 may not lap with the 1st tie way 163, and the end section 311 currently formed thickly has the predetermined capacitance C3.

[0065] That of this 3rd tie way 310 doubles the parts 312 of the end section 311 and others, and constitutes the quarter-wave length resonator according to the center frequency of the signal which intervenes this component and spreads the transmission line.

[0066] The laminating balun component of the above-mentioned configuration has an equal circuit as shown in drawing 17 , an inductance L1 intervenes

between the 1st parallel terminal 124 and the other end of the 3rd tie way 310, and while the end of the 3rd joint terminal 310 is grounded, capacitance C3 intervenes between this end and touch-down. Furthermore, capacitance C1 intervenes between the 2nd balance terminal 123 and touch-down, and capacitance C2 intervenes between the unbalance terminal 126 and touch-down. The output difference and phase contrast of a signal of the 1st balance terminal 124 and the 2nd balance terminal 123 are set up in predetermined tolerance with these inductance L1 and capacitance C1, C2, and C3. Thus, the difference between the amplitude between the output signal of the 1st balance terminal 124 and the output signal of the 2nd balance terminal 123 and a phase can be lost by replacing with an inductance L2 according to the mounting environment of a balun component, and forming capacitance C3.

[0067] Therefore, also by preparing the setting modification section which has capacitance C3 like the 2nd operation gestalt, even if the main unit using a laminating balun component changes, the laminating balun component which has the always optimal property can be offered. Furthermore, since the time and effort and cost in the case of redesigning whenever the main unit changes are sharply reducible compared with the former, a cheap laminating balun component can be offered.

[0068] Next, the 3rd operation gestalt of this invention is explained.

[0069] The laminating balun component which formed the 3rd tie way 320 of the configuration which replaces with the 3rd tie way 164 formed in the dielectric layer 138 of the 8th layer in the 1st operation gestalt mentioned above, and is shown in drawing 18 consisted of 3rd operation gestalten.

[0070] nothing and its end 320a are connected to the external terminal 125 used as an earth terminal, and other end 320b arranges the shape of spiral shape to which the 3rd tie way 320 laps with the 1st tie way 163 in the same location as other end 163b of the 1st tie way 163 -- having -- a beer hall -- the conductor 182 is formed. Moreover, the 3rd tie way 320 in this operation gestalt constitutes the quarter-wave length resonator according to the center frequency of the signal

with which the whole is formed in the almost same width of face, intervenes this component, and spreads the transmission line. Furthermore, the opening stub 330 as the setting modification section is connected to the end section of the 3rd tie way 320.

[0071] the band-like conductor with which, as for the opening stub 330, the end 330a was connected to the end section of the 3rd tie way 320, and the other end was opened wide -- consisting of a piece, the width of face W4 is formed almost equally to the width of face W2 of the 3rd tie way 320, and has the predetermined susceptance B1 (reactance).

[0072] The laminating balun component of the above-mentioned configuration has an equal circuit as shown in drawing 17 , an inductance L1 intervenes between the 1st parallel terminal 124 and the other end of the 3rd tie way 320, and while the opening stub 330 which has a susceptance B1 (reactance) in the end section of the 3rd joint terminal 320 is connected, the end of the 3rd joint terminal 320 is grounded. Furthermore, capacitance C1 intervenes between the 2nd balance terminal 123 and touch-down, and capacitance C2 intervenes between the unbalance terminal 126 and touch-down. The output difference and phase contrast of a signal of the 1st balance terminal 124 and the 2nd balance terminal 123 are set up in predetermined tolerance according to these inductance L1 and capacitance C1 and C2, and a susceptance B1. Thus, the difference between the amplitude between the output signal of the 1st balance terminal 124 and the output signal of the 2nd balance terminal 123 and a phase can be lost by replacing with an inductance L2 according to the mounting environment of a balun component, and establishing a susceptance B1.

[0073] Therefore, also by preparing the setting modification section which consists of an opening stub 330 which has a susceptance B1 like the 3rd operation gestalt, even if the main unit using a laminating balun component changes, the laminating balun component which has the always optimal property can be offered. Furthermore, since the time and effort and cost in the case of redesigning whenever the main unit changes are sharply reducible compared

with the former, a cheap laminating balun component can be offered.

[0074] In addition, each operation gestalt mentioned above is one example of this invention, and the invention in this application is not limited only to the configuration of these examples. For example, although the above-mentioned operation gestalt explained the setting modification section prepared in the 3rd tie way, the same setting modification section as other 1st, 2nd, or 4th tie ways may be prepared.

[0075] moreover -- the above-mentioned operation gestalt -- the conductor as the setting modification section -- although two pieces 167,168 were formed, when it is not necessary to prepare, or when preparing in all the unbalance terminals 126 and 1st and 2nd balance terminals 124,123, it cannot be overemphasized that you may set up suitably.

[0076] Moreover, it cannot be overemphasized by changing the configuration of the path cord way 165 as the setting modification section into the configuration which bends two or more times as shown in drawing 20 or drawing 21 that the inductance of the path cord way 165 can be changed.

[0077] moreover -- the above-mentioned operation gestalt -- the conductor of the vertical direction of the laminating element assembly 110 which forms capacitance C1 and C2 in the layer of a center section mostly -- the layer near [when mounting in the circuit board of the main unit, although the piece 167,168 was formed] the top face -- a conductor -- it is desirable to form a piece 167,168. since [namely,] the external terminals 121-126 are extended and formed in the side face of the laminating element assembly 110 from the base on the top face -- a conductor -- the conductor of the external terminals 121-126 of the part above the location where the piece 167,168 was connected -- a part may serve as an unnecessary opening stub and the susceptance (reactance) may change with change of a mounting environment therefore, a conductor -- since said unnecessary opening stub is not formed by forming a piece 167,168 near the top face of the laminating element assembly 110, it is stabilized and the property when mounting a laminating balun component in the main unit can be acquired.

[0078] Moreover, although the laminating of the dielectric layer was carried out and the laminating element assembly 110 was formed with the above-mentioned operation gestalt, not to be limited to a dielectric layer and what is necessary is just an insulator layer.

[0079]

[Effect of the Invention] As explained above, according to the laminating balun component of this invention according to claim 1 to 9, the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal can be set up in said tolerance by designing by changing the value of the reactance of the setting modification section according to the difference in the mounting environment of a balun component. Thereby, if only said setting modification section is changed according to the mounting environment of a balun component at the time of redesign, it can design easily in a short time so that the output difference and phase contrast of a signal of said 1st balance terminal and said 2nd balance terminal may come in predetermined tolerance. Furthermore, the laminating balun component which has the property which was excellent with the above-mentioned design can be offered at a low price.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The decomposition perspective view showing the configuration of the laminating balun component in the 1st operation gestalt of this invention

[Drawing 2] The appearance perspective view showing the laminating balun component of the conventional example

[Drawing 3] The representative circuit schematic of the laminating balun component of the conventional example

[Drawing 4] The decomposition perspective view showing the configuration of the laminating balun component of the conventional example

[Drawing 5] The Smith chart showing the property of the laminating balun component of the conventional example

[Drawing 6] Drawing explaining the trouble of the laminating balun component of the conventional example

[Drawing 7] The appearance perspective view showing the laminating balun component in the 1st operation gestalt of this invention

[Drawing 8] The representative circuit schematic of the laminating balun component in the 1st operation gestalt of this invention

[Drawing 9] The top view showing the 1st tie way in the 1st operation gestalt of this invention

[Drawing 10] The top view showing the 3rd tie way in the 1st operation gestalt of this invention

[Drawing 11] The top view showing the path cord way as the setting modification section in the 1st operation gestalt of this invention

[Drawing 12] The top view showing the 4th tie way in the 1st operation gestalt of this invention

[Drawing 13] The top view showing the 2nd tie way in the 1st operation gestalt of this invention

[Drawing 14] The Smith chart showing the property of the laminating balun component in the 1st operation gestalt of this invention

[Drawing 15] Drawing showing the I/O signal wave form of the laminating balun component in the 1st operation gestalt of this invention

[Drawing 16] The top view showing the 3rd tie way in the 2nd operation gestalt of this invention

[Drawing 17] The representative circuit schematic of the laminating balun component in the 2nd operation gestalt of this invention

[Drawing 18] The top view showing the 3rd tie way in the 3rd operation gestalt of this invention

[Drawing 19] The representative circuit schematic of the laminating balun component in the 3rd operation gestalt of this invention

[Drawing 20] The top view showing other examples of a configuration of the path cord way as the setting modification section concerning this invention

[Drawing 21] The top view showing other examples of a configuration of the path cord way as the setting modification section concerning this invention

[Description of Notations]

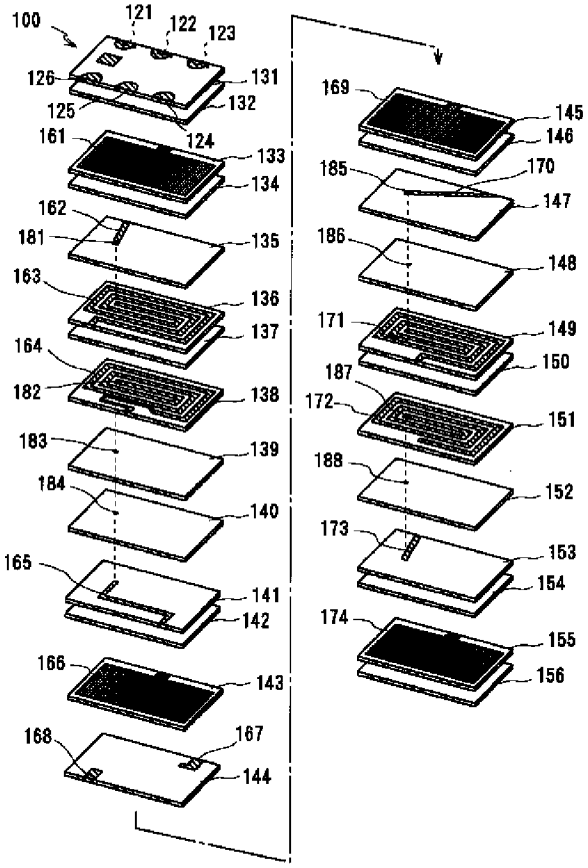
100 [-- External terminal (earth terminal),] -- A laminating balun component, 110 -- A laminating element assembly, 121 -- An external terminal, 122,125 123 -- An external terminal (the 2nd balance terminal), 124 -- External terminal (the 1st balance terminal), 126 -- an external terminal (unbalance terminal), a 131 - 156 -- dielectric layer, and 161,166,169,174 -- touch-down -- a conductor -- 162,170,173 -- A path cord way, 163 -- The 1st tie way, 164 -- The 3rd tie way, the 164c-- setting modification section, a 165 -- path cord way (setting modification section), and 167,168 -- a conductor -- a piece (setting modification section) -- 171 -- the 4th tie way, the 172 -- 2nd tie way, and a 181 - 188 -- beer hall -- a conductor, the 310 -- 3rd tie way, and 311 -- the setting modification section, the 320 -- 3rd tie way, and 330 -- opening stub.

[Translation done.]

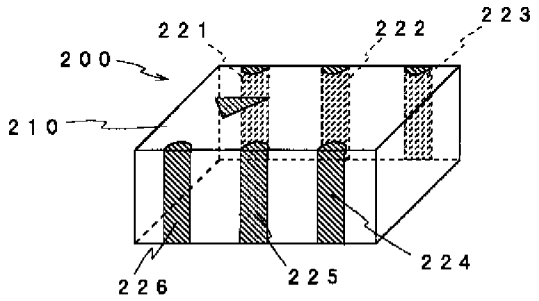
* NOTICES *

DRAWINGS

[Drawing 1]

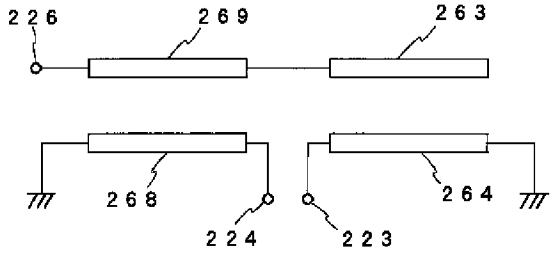


[Drawing 2]



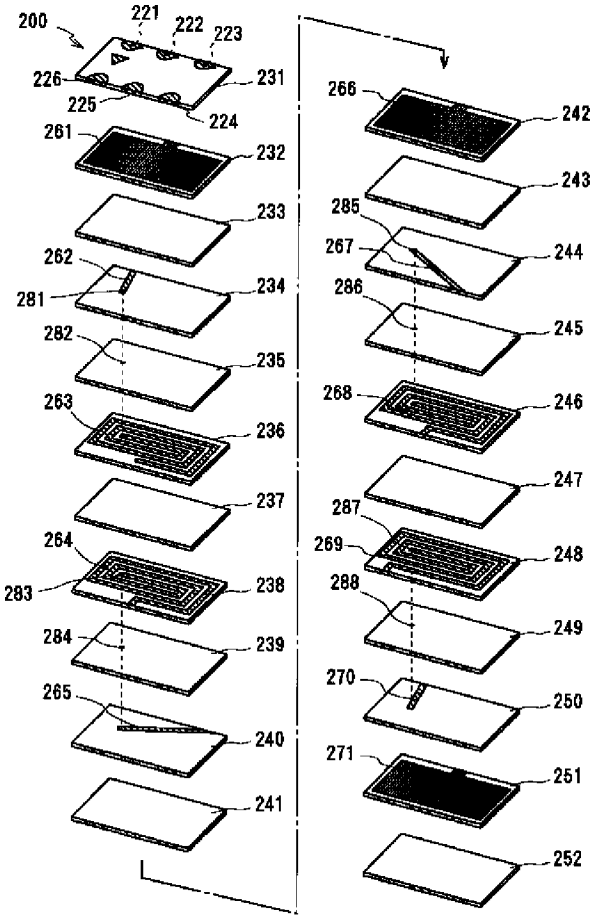
従来例

[Drawing 3]



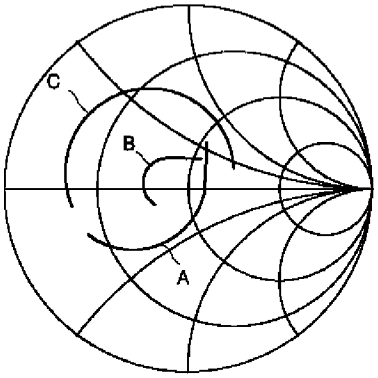
従来例

[Drawing 4]



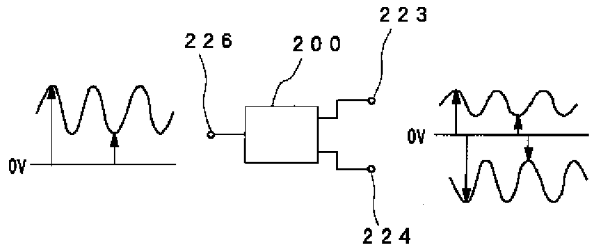
従来例

[Drawing 5]



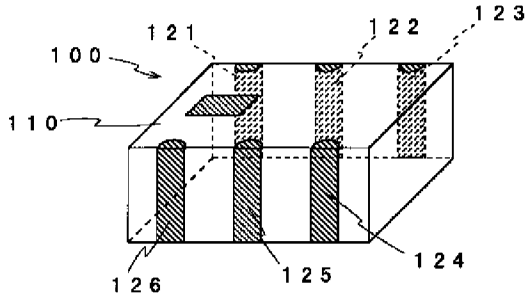
従来例

[Drawing 6]

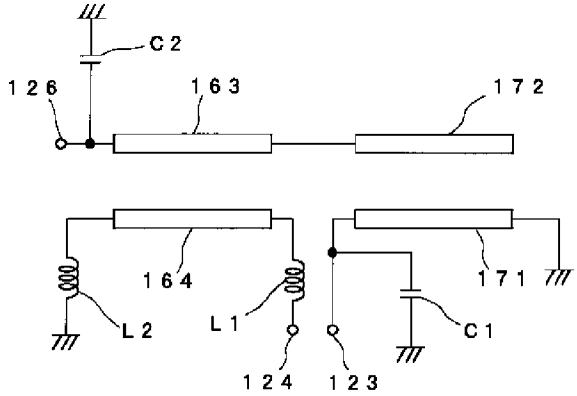


従来例

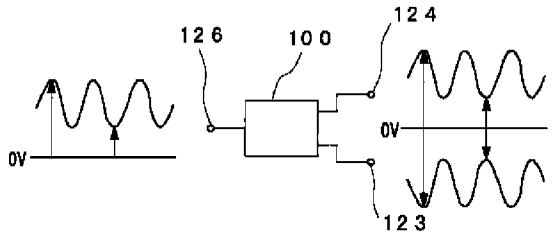
[Drawing 7]



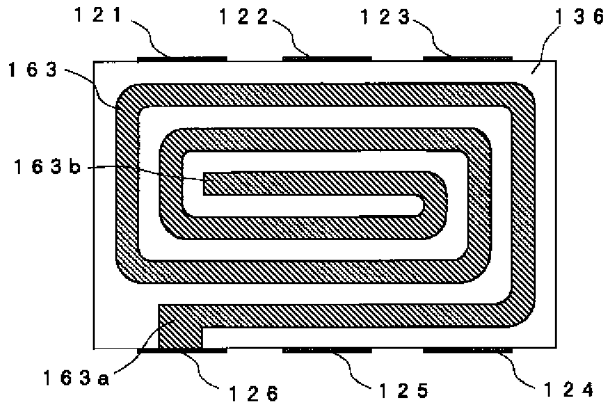
[Drawing 8]



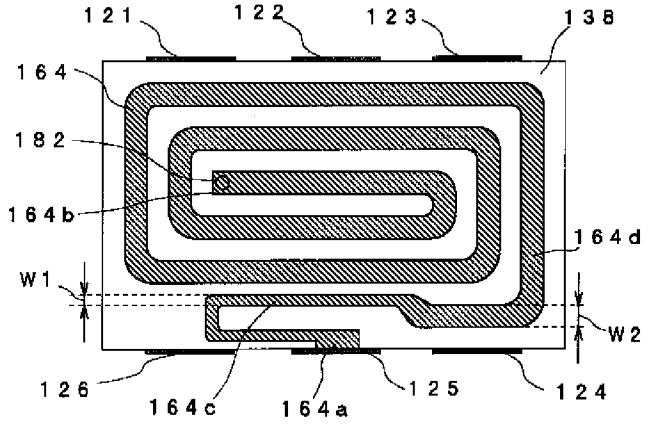
[Drawing 15]



[Drawing 9]



[Drawing 10]



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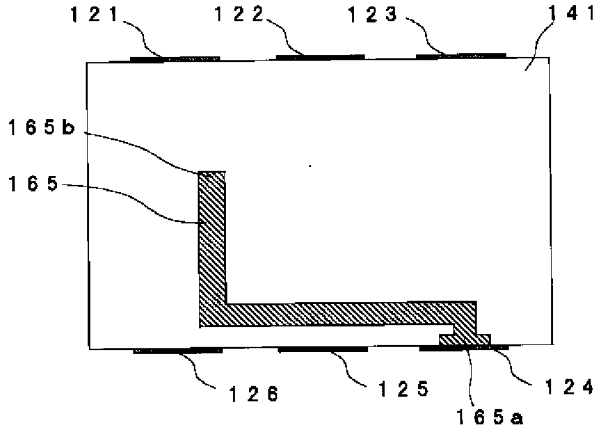
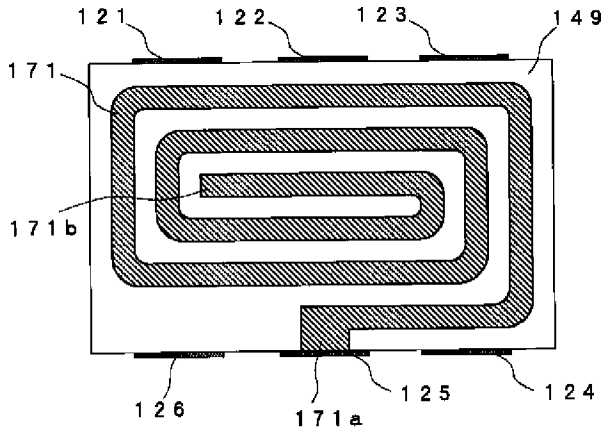
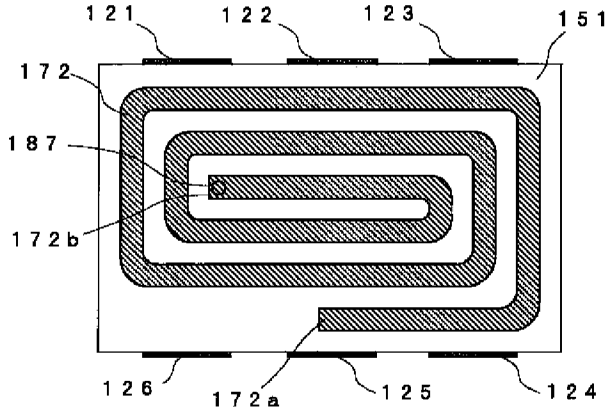


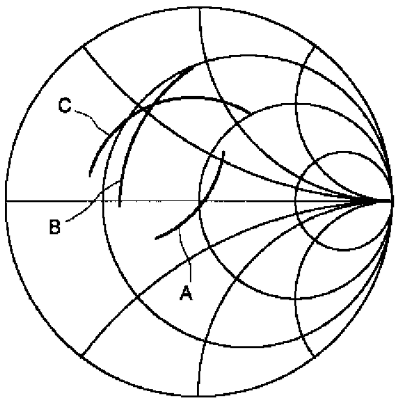
[Drawing 12]



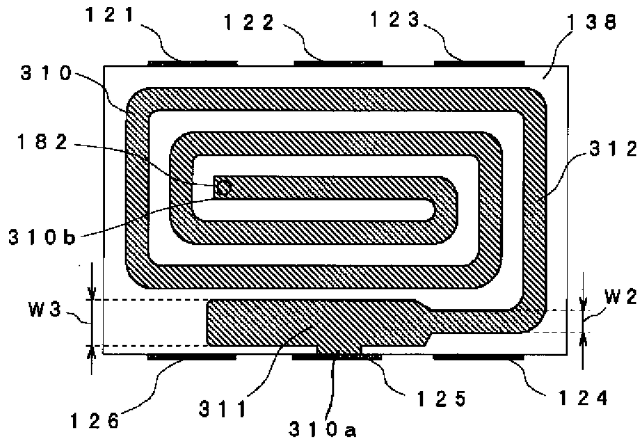
[Drawing 13]



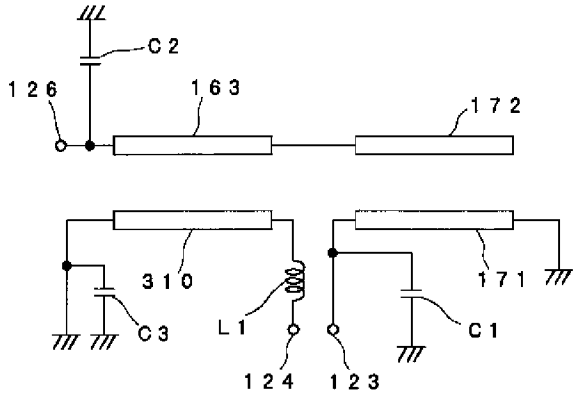
[Drawing 14]



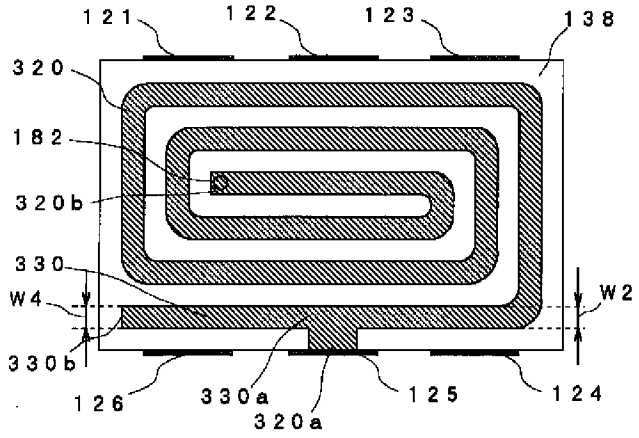
[Drawing 16]



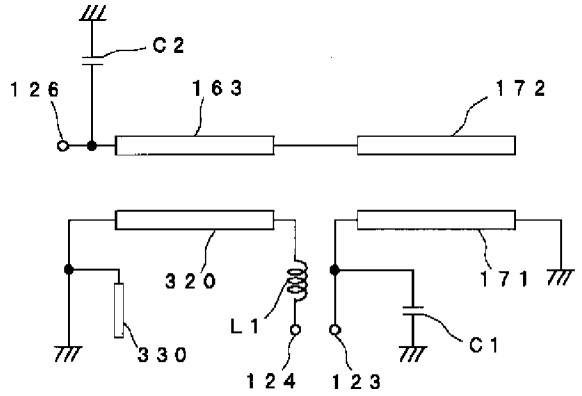
[Drawing 17]



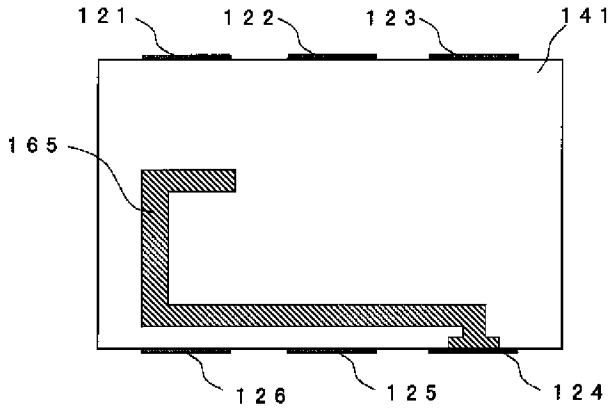
[Drawing 18]



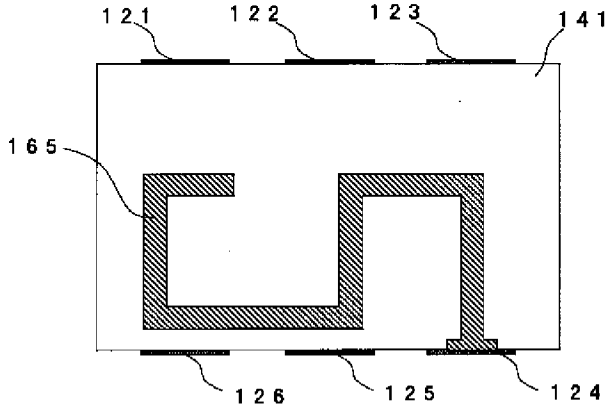
[Drawing 19]



[Drawing 20]



[Drawing 21]



[Translation done.]

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Ｈ０１Ｆ　17/00		Ｈ０１Ｆ　17/00	Ｂ	
			Ｄ	
19/06		19/06		
Ｈ０３Ｈ　7/42		Ｈ０３Ｈ　7/42		

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(22)出願日　平成13年３月６日(2001.3.6)

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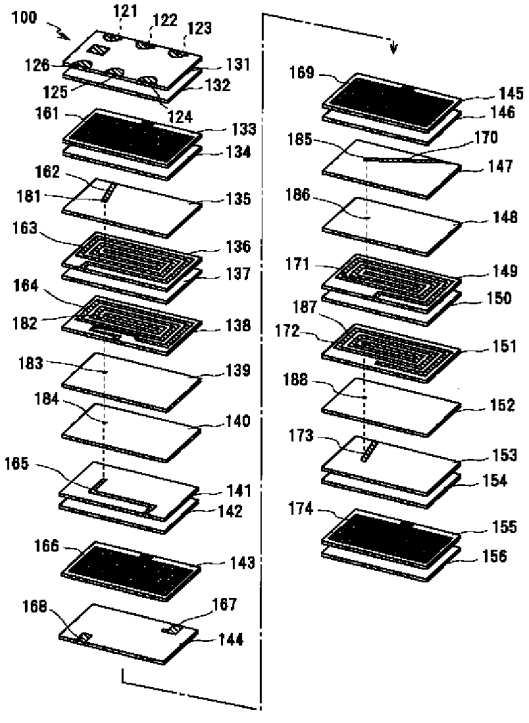
Ｆターム(参考)　5E070 AA16 AB04 CB13

(54)【発明の名称】　積層バラン素子

(57)【要約】
【課題】　主装置に実装したときに第１平衡端子と第２平衡端子の信号の出力と位相のそれぞれに大きな差が生じないように、容易に設計できる積層バラン素子を提供する。
【解決手段】　第１平衡端子124と第２平衡端子123のインピーダンスの大きさの差及び信号の位相差が所定の許容範囲内になるように設定されたインダクタンスを有する設定変更部を接地端部に設けた第３結合線路164を備えると共に、第３結合線路164の他端と第１平衡端子124とを接続する接続線路165を設定変更部として所定のインダクタンスを持つように設定し、さらに不平衡端子126と第２平衡端子123のそれぞれに所定のキャパシタンスを有する導体片167,168を設定変更部として接続した積層バラン素子100を構成する。実装環境に合わせた再設計時に設定変更部のリアクタンスを変化させて良好な特性を得る。



【特許請求の範囲】
【請求項１】　積層素体の内部に絶縁体層を介して互いに重なるように積層して形成されて互いに電磁結合し且つそれぞれが１／４波長共振器を構成する少なくとも２つの結合線路を１組として２組の結合線路を有すると共に、外部に露出する不平衡端子と第１及び第２平衡端子と接地端子とを有し、不平衡伝送線路と平衡伝送線路とを結合する積層バラン素子において、
前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が所定の許容範囲内になるように設定されたリアクタンスを有する設定変更部が、前記結合線路のうちの少なくとも１つの結合線路の端部に設けられていることを特徴とする積層バラン素子。
【請求項２】　前記設定変更部は、前記結合線路の一部であり且つ互いに電磁結合する他の結合線路に対して重なり合わない部分を有すると共に、
該重なり合わない部分において、設定変更部の線路幅が設定変更部以外の部分の線路幅と異なることを特徴とする請求項１に記載の積層バラン素子。
【請求項３】　前記設定変更部が所定のインダクタンスを有するように、前記設定変更部の線路幅が設定変更部以外の部分の線路幅よりも細く設定されていることを特徴とする請求項２に記載の積層バラン素子。
【請求項４】　前記設定変更部が所定のキャパシタンスを有するように、前記設定変更部の線路幅が設定変更部位外の部分の線路幅よりも太く設定されていることを特徴とする請求項２に記載の積層バラン素子。
【請求項５】　前記不平衡端子と第１及び第２平衡端子のうちの少なくとも１つと該端子に対応する前記結合線路との間に、これらの間を接続する接続線路が前記設定変更部として設けられ、前記接続線路は前記結合線路が形成されている層とは異なる層に形成されており、
前記接続線路と前記接続線路に接続される結合線路との間に介在する絶縁体層の厚さは、前記１組のうちの隣り合って積層された結合線路間に介在する絶縁体層の厚さよりも大きく設定されていることを特徴とする請求項１に記載の積層バラン素子。
【請求項６】　前記設定変更部として、一端が前記結合線路の端部に接続され他端が開放された導体線路からなり且つ所定のリアクタンスを有するオープンスタブが設けられていることを特徴とする請求項１に記載の積層バラン素子。
【請求項７】　前記不平衡端子と第１平衡端子と第２の平衡端子のうちの少なくとも１つの端子に対して、前記積層素体内部に設けられ且つ所定のキャパシタンスを有する導体片が前記設定変更部として接続されていることを特徴とする請求項１乃至請求項６の何れかに記載の積層バラン素子。
【請求項８】　前記積層素体は積層バラン素子が搭載される面に対向する底面を有する直方体形状をなし、
前記不平衡端子と第１及び第２平衡端子が、前記積層素体の側面に前記底面から上面に延ばして形成されており、
前記導体片が前記積層素体上面の近傍に設けられていることを特徴とする請求項７に記載の積層バラン素子。
【請求項９】　一端が前記不平衡端子に接続された第１結合線路と、
一端が開放され他端が前記第１結合線路の他端に接続された第２結合線路と、
一端が前記接地端子に接続されると共に他端が前記第１平衡端子に接続され、絶縁体層を介して前記第１結合線路に重なるように配置されて前記第１結合線路と電磁結合する第３結合線路と、
一端が接地外部端子に接続されると共に他端が第２平衡端子に接続され、絶縁体層を介して前記第２結合線路に重なるように配置されて前記第２結合線路と電磁結合する第４結合線路と、
前記接地端子に接続され、前記一方の結合線路の組と他方の結合線路の組との間の電磁結合を抑制する接地導体とを備えていることを特徴とする請求項１乃至請求項８の何れかに記載の積層バラン素子。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、携帯型電話機や携帯型無線通信機において平衡伝送線路と不平衡伝送線路との間に介在してこれらの異なる２つの伝送線路間を結合するバラン素子に関するものである。
【０００２】
【従来の技術】従来、携帯型電話機や携帯型無線通信機において送受信回路とアンテナとを接続する場合、アンテナ側が不平衡伝送線路となり送受信回路側が平衡伝送線となるので、これらの間の整合を取るためにバランを介在させている。ここでバランとは高周波伝送線路の平衡・不平衡変換器である。
【０００３】近年において携帯型電話機や携帯型無線通信機は小型化及び高周波化の傾向が強まり、これに伴ってバランも小型化され、フェライトコアに導線を巻き付けて形成したものから積層素体の内部に導体を埋設して形成した積層バラン素子が用いられるようになってきた。
【０００４】この種の積層バラン素子の一例を図２及び図３に示す。図２は外観図、図３はその等価回路図、図４は分解斜視図である。図において、200は積層バラン素子で、直方体形状の積層素体210とその外表面に形成された外部端子221～226から成る。ここで、外部端子226は不平衡伝送線路に接続される不平衡端子であり、外部端子224は１対の平衡伝送線路の一方に接続される第１平衡端子、外部端子223は他方の平衡線路に接続される第２平衡端子、外部端子222,225は接地端子、外部端子221は外部回路と非接続の端子である。

【０００５】積層素体２１は、図４に示すように、表面に接地導体261,266,271が設けられた誘電体層232,242,251と、渦巻き状の結合線路263,264,268,269が表面に設けられた誘電体層236,238,246,248、結合線路と外部端子とを接続する接続線路262,265,267,270が表面に設けられた誘電体層234,240,244,250、ダミーの誘電体層231,233,235,237,239,241,243,245,247,249,252が積層されて構成されている。

【０００６】結合線路269の一端は外部端子（不平衡端子）226に接続され、他端は接続線路270,262を介して結合線路263の一端に接続されている。結合線路263の他端は開放されている。

【０００７】また、結合線路264の一端は接続線路265を介して外部端子（第１平衡端子）223に接続され、他端は接地端子225に接続されている。結合線路268の一端は接続線路267を介して外部端子（第２平衡端子）224に接続され、他端は接地端子225に接続されている。

【０００８】結合線路263と結合線路264は誘電体層236,237を介して互いに電磁結合し、結合線路268と結合線路269は誘電体層246,247を介して互いに電磁結合している。これらの結合線路263,264,268,269は、本素子200を介在する伝送線路を伝搬する信号の中心周波数に応じた、電気長が１／４波長である所定幅のストリップラインによって形成されている。

【０００９】また、異なる誘電帯層の表面に形成されている結合線路と接続線路との間はビアホール導体281～283によって接続され、接続線路262,265,267,270はビアホール導体と外部端子との間の最短経路に沿って形成されている。

【００１０】

【発明が解決しようとする課題】しかしながら、前述した従来例の積層バラン素子においては、主装置の回路基板へ実装したときの周囲の導体及び電子部品の配置などの実装環境の違いによって第１平衡端子と第２平衡端子のインピーダンス及び位相に大きく差が生じることがあった。例えば、実装環境によっては図５のスミス図表に示すような特性になり、第１平衡端子223の特性Ｂと第２平衡端子224の特性Ｃの間の違いが大きくなった。図５は周波数２．０ＧＨｚ～３．０ＧＨｚにおける特性である。

【００１１】その結果、図６に示すように第１平衡端子223の出力信号と第２平衡端子224の出力信号との間の振幅及び位相の違いが大きくなることがあった。このため、主装置が変わる毎に設計をやり直さなければならなかった。この再設計において、非常に多くの時間がかかると共に、素子のコストが高くなり廉価にて提供できないという問題点があった。

【００１２】本発明の目的は上記の問題点に鑑み、主装置に実装したときに第１平衡端子と第２平衡端子の信号の出力及び位相のそれぞれに大きな差が生じないように、容易に設計できる積層バラン素子を提供することである。

【００１３】

【課題を解決するための手段】本発明は上記の目的を達成するために請求項１では、積層素体の内部に絶縁体層を介して互いに重なるように積層して形成されて互いに電磁結合し且つそれぞれが１／４波長共振器を構成する少なくとも２つの結合線路を１組として２組の結合線路を有すると共に、外部に露出する不平衡端子と第１及び第２平衡端子と接地端子とを有し、不平衡伝送線路と平衡伝送線路とを結合する積層バラン素子において、前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が所定の許容範囲内になるように設定されたリアクタンスを有する設定変更部が、前記結合線路のうちの少なくとも１つの結合線路の端部に設けられている積層バラン素子を提案する。

【００１４】該積層バラン素子によれば、設計時において前記設定変更部のリアクタンスの値が変化されて、前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が前記許容範囲内に設定されている。これにより、バラン素子の実装環境に合わせて、前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が所定の許容範囲内になるように容易に短時間で設計することができる。

【００１５】また、請求項２では、請求項１に記載の積層バラン素子において、前記設定変更部は、前記結合線路の一部であり且つ互いに電磁結合する他の結合線路に対して重なり合わない部分を有すると共に、該重なり合わない部分において、設定変更部の線路幅が設定変更部以外の部分の線路幅と異なる積層バラン素子を提案する。

【００１６】該積層バラン素子によれば、前記結合線路の一部が設定変更部とされ、前記設定変更部を含む前記結合線路は１／４波長共振器をなしている。さらに、前記設定変更部を含む結合線路は、互いに電磁結合する他の結合線路に対して前記設定変更部において重なり合わない部分を有し、該重なり合わない部分において、設定変更部の線路幅が設定変更部以外の部分の線路幅とは異なった形状、例えば細く或いは太く形成されて、所定のリアクタンスを有する。

【００１７】また、請求項３では、請求項２に記載の積層バラン素子において、前記設定変更部が所定のインダクタンスを有するように、前記設定変更部の線路幅が設定変更部以外の部分の線路幅よりも細く設定されている積層バラン素子を提案する。

【００１８】該積層バラン素子によれば、前記設定変更部の線路幅が設定変更部以外の部分の線路幅よりも細く形成され、前記設定変更部が所定のインダクタンスを有するように設定されている。

【００１９】また、請求項４では、請求項２に記載の積

層バラン素子において、前記設定変更部が所定のキャパシタンスを有するように、前記設定変更部の線路幅が設定変更部位外の部分の線路幅よりも太く設定されている積層バラン素子を提案する。

【００２０】該積層バラン素子によれば、前記設定変更部の線路幅が設定変更部以外の部分の線路幅よりも太く形成され、前記設定変更部が所定のキャパシタンスを有するように設定されている。

【００２１】また、請求項５では、請求項１に記載の積層バラン素子において、前記不平衡端子と第１及び第２平衡端子のうちの少なくとも１つと該端子に対応する前記結合線路との間に、これらの間を接続する接続線路が前記設定変更部として設けられ、前記接続線路は前記結合線路が形成されている層とは異なる層に形成されており、前記接続線路と前記接続線路に接続される結合線路との間に介在する絶縁体層の厚さは、前記１組のうちの隣り合って積層された結合線路間に介在する絶縁体層の厚さよりも大きく設定されている積層バラン素子を提案する。

【００２２】該積層バラン素子によれば、前記不平衡端子と第１及び第２平衡端子のうちの少なくとも何れか１つと該端子に対応する前記結合線路との間に、これらの間を接続する接続線路が前記設定変更部として設けられている。さらに、前記接続線路は前記結合線路が形成されている層とは異なる層に形成されており、前記接続線路と前記接続線路に接続される結合線路との間に介在する絶縁体層の厚さは、前記結合線路との間の電磁結合を弱める或いは無くすために、前記１組のうちの隣り合って積層された結合線路間に介在する絶縁体層の厚さよりも大きく設定されている。

【００２３】また、請求項６では、請求項１に記載の積層バラン素子において、前記設定変更部として、一端が前記結合線路の端部に接続され他端が開放された導体線路からなり且つ所定のリアクタンスを有するオープンスタブが設けられている積層バラン素子を提案する。

【００２４】該積層バラン素子によれば、前記結合線路の端部にオープンスタブが接続され、該オープンスタブが前記設定変更部として所定のリアクタンスを有する。

【００２５】また、請求項７では、請求項１乃至請求項６の何れかに記載の積層バラン素子において、前記不平衡端子と第１平衡端子と第２の平衡端子のうちの少なくとも１つの端子に対して、前記積層素体内部に設けられ且つ所定のキャパシタンスを有する導体片が前記設定変更部として接続されている積層バラン素子を提案する。

【００２６】該積層バラン素子によれば、前記不平衡端子と第１平衡端子と第２の平衡端子のうちの少なくとも１つの端子に導体片が接続され、該導体片が所定のキャパシタンスを有する前記設定変更部となって前記結合線路の端部に接続されている。

【００２７】また、請求項８では、請求項７に記載の積層バラン素子において、前記積層素体は積層バラン素子が搭載される面に対向する底面を有する直方体形状をなし、前記不平衡端子と第１及び第２平衡端子が、前記積層素体の側面に前記底面から上面に延ばして形成されており、前記導体片が前記積層素体上面の近傍に設けられている積層バラン素子を提案する。

【００２８】該積層バラン素子によれば、前記積層素体が直方体形状を有し、前記不平衡端子と第１及び第２平衡端子が前記積層素体の側面に底面から上面に延ばして形成されているため、これらの端子の上部すなわち前記積層素体の上面近傍の部分が不要なオープンスタブとなって実装環境の変化によってそのリアクタンスが変化することがある。しかし、前記導体片が前記積層素体上面の近傍に設けられているので前記不要なオープンスタブが形成されることが無く、さらに設計時において前記導体片のキャパシタンスが最適な値に設定されているので前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が前記許容範囲内になる。

【００２９】また、請求項９では、請求項１乃至請求項８の何れかに記載の積層バラン素子において、一端が前記不平衡端子に接続された第１結合線路と、一端が開放され他端が前記第１結合線路の他端に接続された第２結合線路と、一端が前記接地端子に接続されると共に他端が前記第１平衡端子に接続され、絶縁体層を介して前記第１結合線路に重なるように配置されて前記第１結合線路と電磁結合する第３結合線路と、一端が接地外部端子に接続されると共に他端が第２平衡端子に接続され、絶縁体層を介して前記第２結合線路に重なるように配置されて前記第２結合線路と電磁結合する第４結合線路と、前記接地端子に接続され、前記一方の結合線路の組と他方の結合線路の組との間の電磁結合を抑制する接地導体とを備えている積層バラン素子を提案する。

【００３０】該積層バラン素子によれば、前記第１結合線路に電磁結合する前記第３結合線路と、前記第２結合線路に電磁結合する前記第４結合線路とを備え、これらの第１乃至第４の結合線路のうちの少なくとも何れか１つに前記設定変更部が設けられ、前記接地導体によって前記一方の結合線路の組と他方の結合線路の組との間の電磁結合が抑制される。

【００３１】

【発明の実施の形態】以下、図面に基づいて本発明の一実施形態を説明する。

【００３２】図１は本発明の第１実施形態における積層バラン素子の構成を示す分解斜視図、図７は外観斜視図、図８はその等価回路図である。図において、100は積層バラン素子で、内部層に結合線路が形成された直方体形状の積層素体110からなり、該積層素体110の外表面には底面から上面に延ばして外部端子121～126が形成されている。外部端子121は外部回路と非接続の端子で、後述する第１結合線路と第２結合線とを接続している。

外部端子122,125は接地端子、外部端子126は不平衡伝送線路に接続される不平衡端子、外部端子124は１対の平衡伝送線路の一方に接続される第１平衡端子、外部端子123は他方の平衡線路に接続される第２平衡端子である。

【００３３】積層素体110は、図１に示すようにそれぞれ同じ厚さを有する複数の誘電体層（絶縁体層）131～156を積層して構成されており、所定層の誘電体層には表面に結合線路又は接続導体或いは接地導体が設けられている。

【００３４】図１において最上層及び第２層目の誘電体層131,132はダミー層であり、第３層目の誘電体層133の表面には接地導体161が設けられている。この接地導体161は接地端子となる外部端子122に接続されている。

【００３５】第４層目の誘電体層134はダミー層である。

【００３６】第５層目の誘電体層135の表面には接続導体162が設けられている。接続導体162は、その一端が外部端子121に接続され、他端部には誘電体層135を表面から裏面に貫通するビアホール導体181が形成され、一端と他端を最短経路で結ぶ帯状をなしている。

【００３７】第６層目の誘電体層136の表面には第１結合線路163が設けられている。第１結合線路163は、図９に示すように、その一端163aが外部端子126に接続され他端163bがビアホール導体181に接続する位置に配置された渦巻き状をなしている。この第１結合線路163は、本素子100を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。

【００３８】第７層目の誘電体層137はダミー層である。

【００３９】第８層目の誘電体層138の表面には、図１０に示すように、一端部164cを除く他の部分164dが第１結合線路163に重なるように渦巻き状の第３結合線路164が設けられている。また、第３結合線路164の一端164aは接地端子となる外部端子125に接続され、他端164bは第１結合線路163の他端163bと同じ位置に配置されてビアホール導体182が形成されている。さらに、第３結合線路164の一端部164cは設定変更部とされ、一端部164cの幅Ｗ１はその他の部分164dの幅Ｗ２よりも細く形成されて、一端部164cの大部分が第１結合線路163に重ならないように配置され、細く形成されている一端部164cが所定のインダクタンスＬ１を有している。

【００４０】この第３結合線路164は一端部164cとその他の部分164dを合わせて、本素子100を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。

【００４１】第９及び第１０層目の誘電体層139,140はダミー層であり、第３結合線路164の他端に形成されたビアホール導体182に対応する位置にそれぞれビアホール導体183,184が設けられ、これらのビアホール導体182～184が連結されている。

【００４２】第１１層目の誘電体層141の表面には接続線路165が設定変更部として設けられている。接続線路165は、図１１に示すように、互いに直角に交わる３つの帯状導体片を直列に連結した略Ｚ字形状をなし、その一端165aが外部端子124に接続され、他端165bはビアホール導体184に対応する位置に配置されてビアホール導体184に接続されている。また、接続導体165が所定のインダクタンスＬ２を有するように、接続導体165の幅や長さ及び配置が設定されている。

【００４３】第１２層目の誘電体層142はダミー層である。

【００４４】第１３層目の誘電体層143の表面には接地導体166が設けられている。この接地導体166は接地端子となる外部端子122に接続されている。

【００４５】第１４層目の誘電体層144の表面には２つの導体片167,168が設定変更部として設けられている。一方の導体片167は外部端子123に接続され、外部端子123近傍の所定面積に形成され、隣接層に形成された接地導体166,169との間で所定のキャパシタンスＣ１を形成している。他方の導体片168は外部端子126に接続され、外部端子126近傍の所定面積に形成され、隣接層に形成された接地導体166,169との間で所定のキャパシタンスＣ２を形成している。

【００４６】第１５層目の誘電体層145の表面には接地導体169が設けられている。この接地導体169は接地端子となる外部端子122に接続されている。

【００４７】第１６層目の誘電体層146はダミー層である。

【００４８】第１７層目の誘電体層147の表面には接続導体170が設けられている。接続導体170は、その一端が外部端子123に接続され、他端部には誘電体層147を表面から裏面に貫通するビアホール導体185が形成され、一端と他端を最短経路で結ぶ帯状をなしている。

【００４９】第１８層目の誘電体層148はダミー層であり、接続線路170の他端に形成されたビアホール導体185に対応する位置にビアホール導体186が設けられ、これらのビアホール導体185,186が連結されている。

【００５０】第１９層目の誘電体層149の表面には第４結合線路171が設けられている。第４結合線路171は、図１２に示すように、その一端171aが接地端子となる外部端子125に接続され、他端がビアホール導体186に接続する位置に配置された渦巻き状をなしている。この第４結合線路171は、本素子100を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。

【００５１】第２０層目の誘電体層150はダミー層である。

【００５２】第２１層目の誘電体層151の表面には、図１３に示すように、第４結合線路171に重なるように渦

巻き状の第２結合線路172が設けられている。また、第２結合線路172の一端172aは開放され、他端172bは第４結合線路171の他端171bと同じ位置に配置されてビアホール導体187が形成されている。この第２結合線路172は、本素子100を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。

【００５３】第２２層目の誘電体層152はダミー層であり、第２結合線路172の他端に形成されたビアホール導体187に対応する位置にビアホール導体188が設けられ、これらのビアホール導体187，188が連結されている。

【００５４】第２３層目の誘電体層153の表面には接続導体173が設けられている。接続導体173は、その一端が外部端子121に接続され、他端部はビアホール導体188に接続される位置に配置され、一端と他端を最短経路で結ぶ帯状をなしている。

【００５５】第２４層目の誘電体層154はダミー層である。

【００５６】第２５層目の誘電体層155の表面には接地導体174が設けられている。この接地導体174は接地端子となる外部端子122に接続されている。

【００５７】第２６層目の誘電体層156はダミー層である。

【００５８】上記構成により、第１結合線路163と第３結合線164とが電磁結合し、第２結合線路172と第４結合線路171とが電磁結合する。さらに、第１結合線路163と第３結合線路164とからなる一方の結合線路の組と、第２結合線路172と第４結合線路171とからなる他方の結合線路の組との間の電磁結合が、接地導体166，169によって抑制されている。

【００５９】上記構成の積層バラン素子100では、４つの設定変更部が設けられているため、その等価回路においては図８に示すように第１平行端子124と第３結合線路164の間にインダクタンスＬ１が介在し、第３結合線路164と接地間にインダクタンスＬ２が介在される。さらに、第２平衡端子123と接地間にキャパシタンスＣ１が介在し、不平衡端子126と接地間にキャパシタンスＣ２が介在する。これらのインダクタンスＬ１，Ｌ２とキャパシタンスＣ１，Ｃ２によって、第１平衡端子124と第２平衡端子123の信号の出力差と位相差が所定の許容範囲内に設定されている。本実施形態の積層バラン素子100の周波数２．０ＧＨｚ～３．０ＧＨｚにおけるスミス図表を作成したところ図１４に示すような特性が得られた。図１４において、Ａは不平衡端子126の特性を表し、Ｂは第１平衡端子124の特性を、またＣは第２平衡端子123の特性をそれぞれ表している。図１４に示すように、第１平衡端子124の特性Ｂと第２平衡端子123の特性Ｃの間の特性の相違は、前述した従来例と比べて大幅に減少してほぼ同じになっている。その結果、図１５に示すように、本実施形態の積層バラン素子100では、第１平衡端子124の出力信号と第２平衡端子123の出力信号との間の振幅及び位相の違いはほとんどなくなった。

【００６０】従って、本実施形態のように設定変更部を設けることにより、積層バラン素子を用いる主装置が変わっても常に最適な特性を有する積層バラン素子を提供することができる。さらに、主装置が変わる毎に再設計を行う場合の手間及びコストを従来に比べて大幅に削減することができるので、廉価な積層バラン素子100を提供することができる。

【００６１】尚、本実施形態では、設定変更部としての接続線路165と第３結合線路164との間に３枚の誘電体層138～140を介在させて接続線路165と第３結合線路164との間の電磁結合を弱める或いは無くすようにしたが、設定変更部としての接続線路165と第３結合線路164との間に介在する誘電体層138～140の厚さの合計は、第１結合線路163と第３結合線路164の間に存在する誘電体層136，137の厚さの合計よりも大きく設定することが好ましく、例えば１．５倍以上に設定することが好ましい。

【００６２】次に、本発明の第２実施形態を説明する。

【００６３】第２実施形態では、前述した第１実施形態における第８層目の誘電体層138に形成される第３結合線路164に代えて図１６に示す形状の第３結合線路310を設けた積層バラン素子を構成した。

【００６４】第３結合線路310は、第１結合線路163に重なるような渦巻き形状をなし、その一端310aは接地端子となる外部端子125に接続され、他端310bは第１結合線路163の他端163bと同じ位置に配置されてビアホール導体182が形成されている。さらに、第３結合線路310の一端部311は設定変更部とされ、一端部311の幅Ｗ３はその他の部分312の幅Ｗ２よりも太く形成されて、一端部311の周縁部分が第１結合線路163に重ならないように配置され、太く形成されている一端部311が所定のキャパシタンスＣ３を有している。

【００６５】この第３結合線路310のは、一端部311とその他の部分312を合わせて、本素子を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。

【００６６】上記構成の積層バラン素子は図１７に示すような等価回路を有し、第１平行端子124と第３結合線路310の他端間にインダクタンスＬ１が介在し、第３結合端子310の一端が接地されると共に該一端と接地間にキャパシタンスＣ３が介在される。さらに、第２平衡端子123と接地間にキャパシタンスＣ１が介在し、不平衡端子126と接地間にキャパシタンスＣ２が介在する。これらのインダクタンスＬ１とキャパシタンスＣ１，Ｃ２，Ｃ３によって、第１平衡端子124と第２平衡端子123の信号の出力差と位相差が所定の許容範囲内に設定されている。この様に、バラン素子の実装環境に応じてインダクタンスＬ２に代えてキャパシタンスＣ３を設けることにより、第１平衡端子124の出力信号と第２平衡端子123の出力信号との間の振幅及び位相の違いをなくすこと

ができる。

【００６７】従って、第２実施形態のようなキャパシタンスＣ３を有する設定変更部を設けることによっても、積層バラン素子を用いる主装置が変わっても常に最適な特性を有する積層バラン素子を提供することができる。さらに、主装置が変わる毎に再設計を行う場合の手間及びコストを従来に比べて大幅に削減することができるので、廉価な積層バラン素子を提供することができる。

【００６８】次に、本発明の第３実施形態を説明する。

【００６９】第３実施形態では、前述した第１実施形態における第８層目の誘電体層138に形成される第３結合線路164に代えて図１８に示す形状の第３結合線路320を設けた積層バラン素子を構成した。

【００７０】第３結合線路320は、第１結合線路163に重なるような渦巻き形状をなし、その一端320aは接地端子となる外部端子125に接続され、他端320bは第１結合線路163の他端163bと同じ位置に配置されてビアホール導体182が形成されている。また、本実施形態における第３結合線路320はその全体がほぼ同一の幅に形成され、本素子を介在して伝送線路を伝搬する信号の中心周波数に応じた１／４波長共振器を構成している。さらに、第３結合線路320の一端部には、設定変更部としてのオープンスタブ330が接続されている。

【００７１】オープンスタブ330は、その一端330aが第３結合線路320の一端部に接続され、他端が開放された帯状の導体片からなり、その幅Ｗ４は第３結合線路320の幅Ｗ２とほぼ等しく形成されて所定のサセプタンスＢ１（リアクタンス）を有している。

【００７２】上記構成の積層バラン素子は図１７に示すような等価回路を有し、第１平行端子124と第３結合線路320の他端間にインダクタンスＬ１が介在し、第３結合端子320の一端部にサセプタンスＢ１（リアクタンス）を有するオープンスタブ330が接続されると共に第３結合端子320の一端が接地されている。さらに、第２平衡端子123と接地間にキャパシタンスＣ１が介在し、不平衡端子126と接地間にキャパシタンスＣ２が介在する。これらのインダクタンスＬ１とキャパシタンスＣ１，Ｃ２及びサセプタンスＢ１によって、第１平衡端子124と第２平衡端子123の信号の出力差と位相差が所定の許容範囲内に設定されている。この様に、バラン素子の実装環境に応じてインダクタンスＬ２に代えてサセプタンスＢ１を設けることにより、第１平衡端子124の出力信号と第２平衡端子123の出力信号との間の振幅及び位相の違いをなくすことができる。

【００７３】従って、第３実施形態のようなサセプタンスＢ１を有するオープンスタブ330からなる設定変更部を設けることによっても、積層バラン素子を用いる主装置が変わっても常に最適な特性を有する積層バラン素子を提供することができる。さらに、主装置が変わる毎に再設計を行う場合の手間及びコストを従来に比べて大幅に削減することができるので、廉価な積層バラン素子を提供することができる。

【００７４】尚、前述した各実施形態は本発明の一具体例であって本願発明がこれらの具体例の構成のみに限定されることはない。例えば上記実施形態では第３結合線路に設けた設定変更部に関して説明したが、他の第１，第２或いは第４結合線路に同様の設定変更部を設けても良い。

【００７５】また、上記実施形態では、設定変更部としての導体片167,168を２つ設けたが、設けなくても良い場合、或いは不平衡端子126と第１及び第２平衡端子124,123の全てに設ける場合など適宜設定して良いことは言うまでもない。

【００７６】また、設定変更部としての接続線路165の形状を例えば図２０或いは図２１に示すように複数回折り曲がる形状に変えることにより、接続線路165のインダクタンスを変化できることは言うまでもない。

【００７７】また、上記実施形態では、積層素体110の上下方向のほぼ中央部の層にキャパシタンスＣ１，Ｃ２を形成する導体片167,168を設けたが、主装置の回路基板に実装したときの上面近傍の層に導体片167,168を設けることが好ましい。即ち、外部端子121～126が積層素体110の側面に底面から上面に延ばして形成されているため、導体片167,168が接続された位置よりも上の部分の外部端子121～126の導体部分が不要なオープンスタブとなって実装環境の変化によってそのサセプタンス（リアクタンス）が変化することがある。従って、導体片167,168を積層素体110の上面近傍に設けることにより、前記不要なオープンスタブが形成されることがないので、積層バラン素子を主装置に実装したときの特性を安定して得ることができる。

【００７８】また、上記実施形態では積層素体110を誘電体層を積層して形成したが、誘電体層に限定されることはなく、絶縁体層であれば良い。

【００７９】

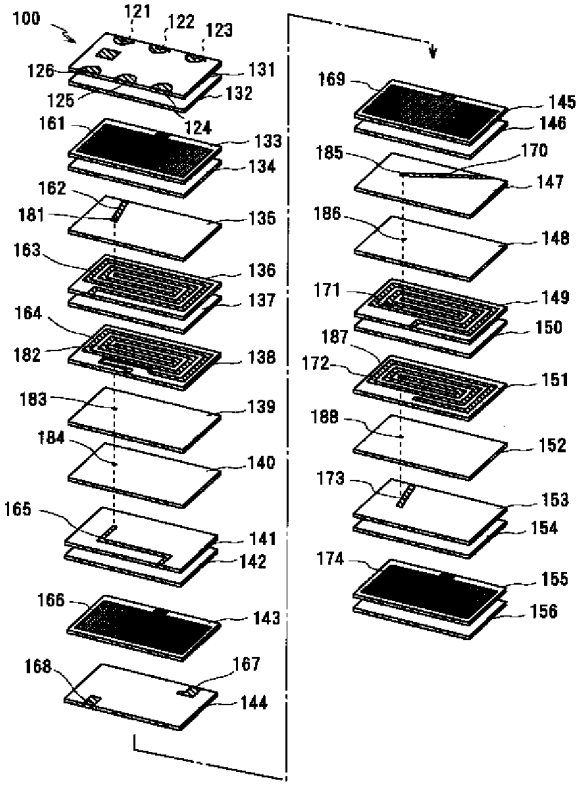
【発明の効果】以上説明したように本発明の請求項１乃至請求項９に記載の積層バラン素子によれば、バラン素子の実装環境の違いに応じて設定変更部のリアクタンスの値を変化させて設計を行うことにより、前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差を前記許容範囲内に設定することができる。これにより、バラン素子の実装環境に合わせて、再設計のときは前記設定変更部のみを変えれば、前記第１平衡端子と前記第２平衡端子の信号の出力差と位相差が所定の許容範囲内になるように容易に短時間で設計することができる。さらに、上記設計によって優れた特性を有する積層バラン素子を廉価にて提供することができる。

【図面の簡単な説明】

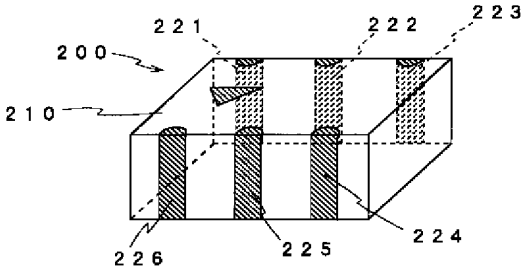
【図１】本発明の第１実施形態における積層バラン素子の構成を示す分解斜視図

【図２】従来例の積層バラン素子を示す外観斜視図
【図３】従来例の積層バラン素子の等価回路図
【図４】従来例の積層バラン素子の構成を示す分解斜視図
【図５】従来例の積層バラン素子の特性を示すスミス図表
【図６】従来例の積層バラン素子の問題点を説明する図
【図７】本発明の第１実施形態における積層バラン素子を示す外観斜視図
【図８】本発明の第１実施形態における積層バラン素子の等価回路図
【図９】本発明の第１実施形態における第１結合線路を示す平面図
【図１０】本発明の第１実施形態における第３結合線路を示す平面図
【図１１】本発明の第１実施形態における設定変更部としての接続線路を示す平面図
【図１２】本発明の第１実施形態における第４結合線路を示す平面図
【図１３】本発明の第１実施形態における第２結合線路を示す平面図
【図１４】本発明の第１実施形態における積層バラン素子の特性を示すスミス図表
【図１５】本発明の第１実施形態における積層バラン素子の入出力信号波形を示す図
【図１６】本発明の第２実施形態における第３結合線路を示す平面図
【図１７】本発明の第２実施形態における積層バラン素子の等価回路図
【図１８】本発明の第３実施形態における第３結合線路を示す平面図
【図１９】本発明の第３実施形態における積層バラン素子の等価回路図
【図２０】本発明に係る設定変更部としての接続線路の他の構成例を示す平面図
【図２１】本発明に係る設定変更部としての接続線路の他の構成例を示す平面図
【符号の説明】
100…積層バラン素子、110…積層素体、121…外部端子、122,125…外部端子（接地端子）、123…外部端子（第２平衡端子）、124…外部端子（第１平衡端子）、126…外部端子（不平衡端子）、131～156…誘電体層、161,166,169,174…接地導体、162,170,173…接続線路、163…第１結合線路、164…第３結合線路、164c…設定変更部、165…接続線路（設定変更部）、167,168…導体片（設定変更部）、171…第４結合線路、172…第２結合線路、181～188…ビアホール導体、310…第３結合線路、311…設定変更部、320…第３結合線路、330…オープンスタブ。

【図１】

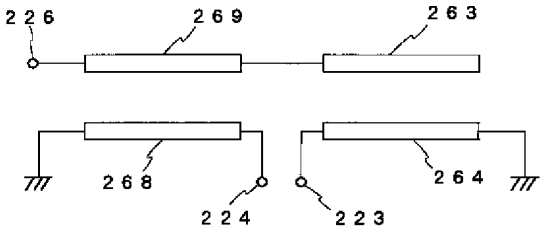


【図２】



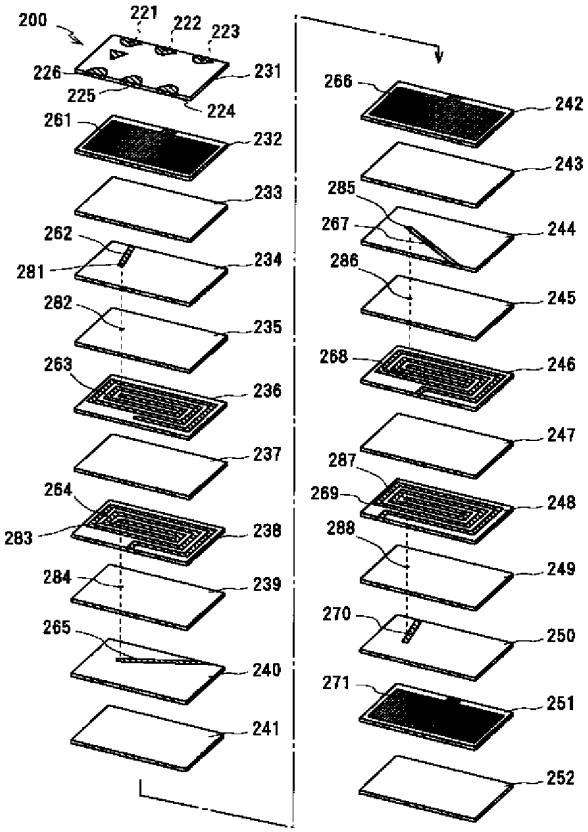
従来例

【図３】



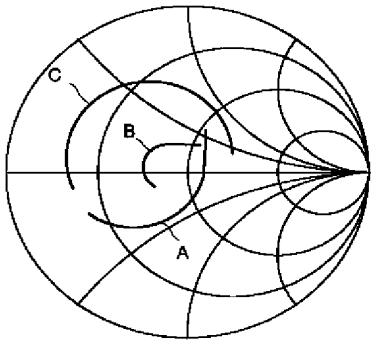
従来例

【図4】



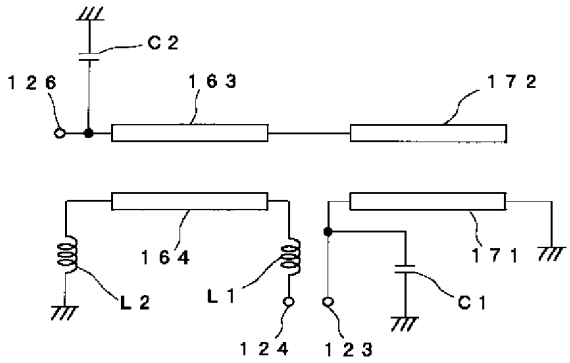
従来例

【図5】



従来例

【図8】



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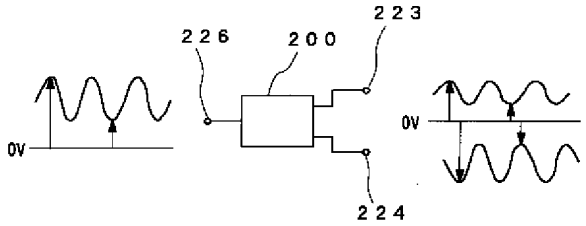
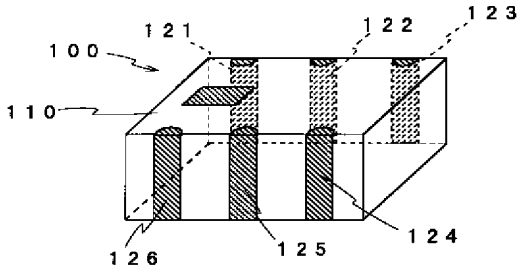


従来例

【図7】



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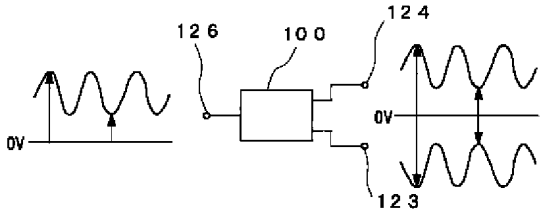

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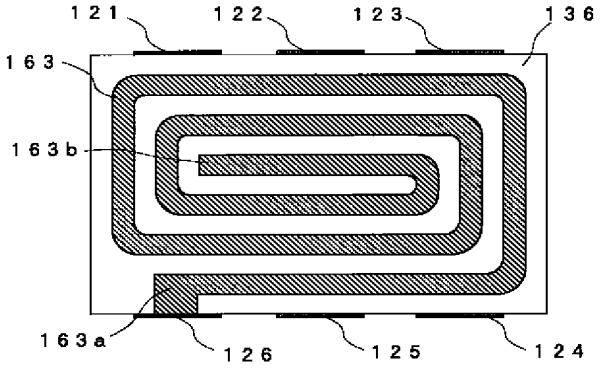
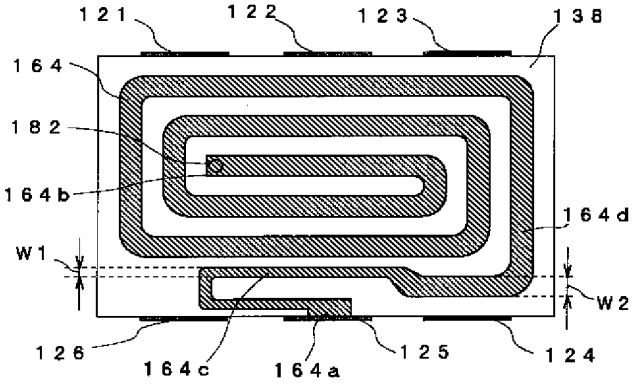


【図10】



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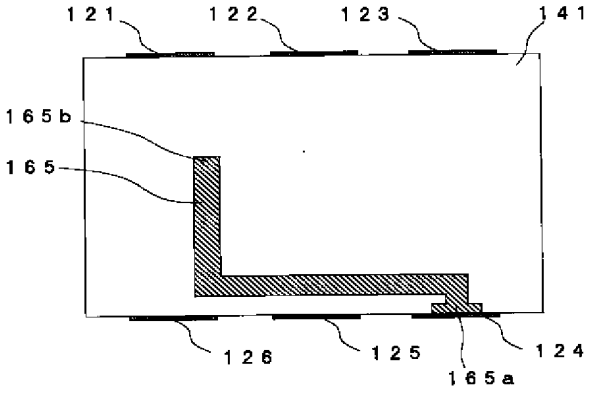
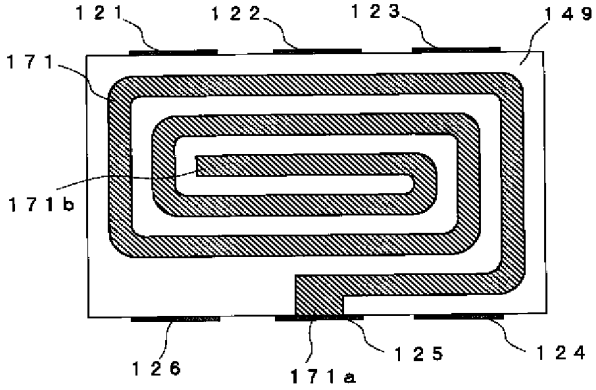


【図12】



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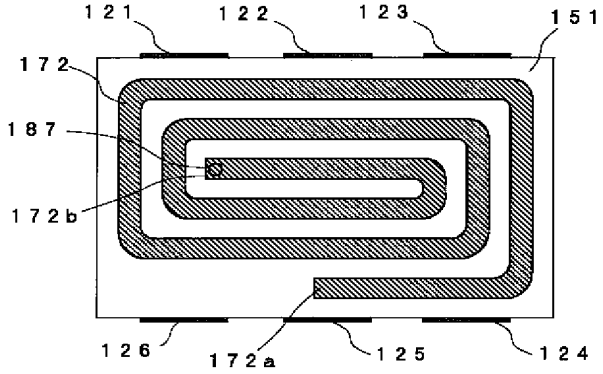

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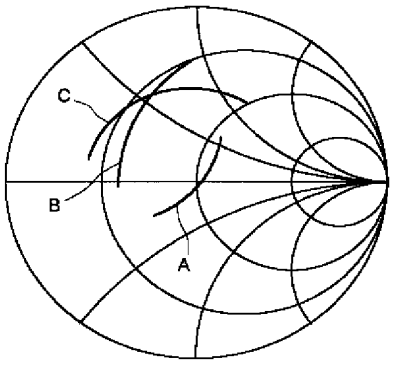

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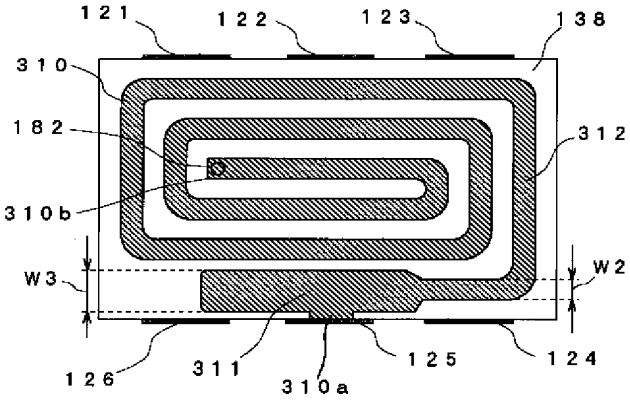

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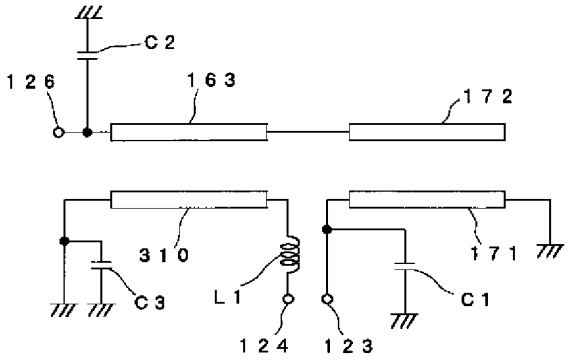

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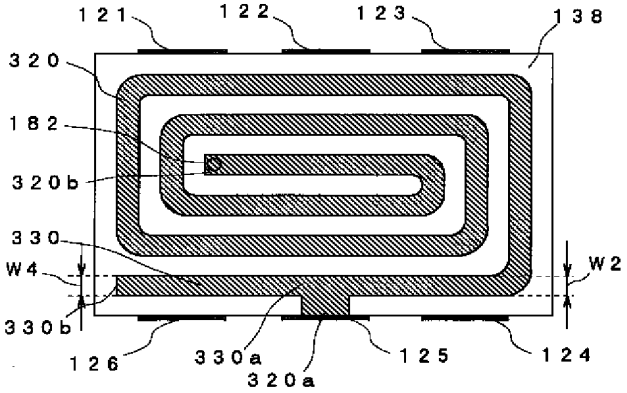
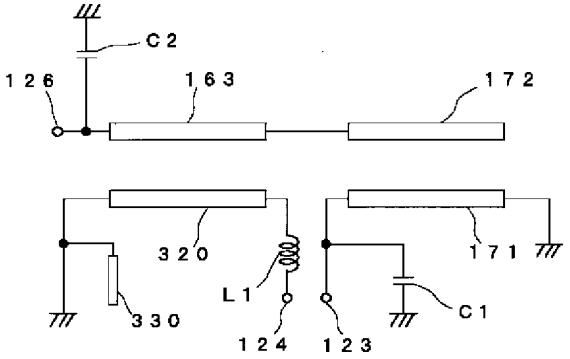


【図19】



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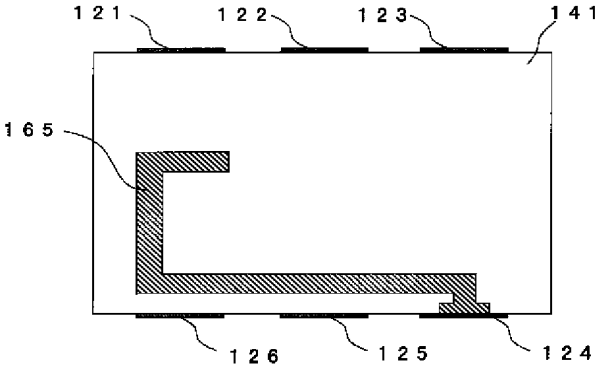

【図21】